IT IS CLAIMED:

1. A method of forming a multilayered-structure composed of two or more discrete monomolecular layers, where each layer is composed of molecules of a selected polycyclic aromatic compound having a defined z axis oriented substantially normal to the plane of the monolayer, said method comprising

(a) depositing molecules of a selected polycyclic aromatic compound having a defined z axis with a chemically reactive group at each axial end, by vapor phase deposition, onto a substrate having surface-reactive sites capable of reacting with the chemically reactive group in the selected compound, said depositing being carried under conditions which allow chemiadsorption of the selected compound in a molecular monolayer, by covalent coupling of one end of the compound to the substrate, and sublimation of non-covalently bonded compounds from the surface,

(b) by said depositing, forming on the substrate, a monomolecular layer of the selected compound characterized by in-plane compound ordering, and

(c) repeating steps (a) and (b) one or more times, where the monomolecular layer formed at each round of steps (a) and (b) forms a new substrate having a surface-exposed monolayer with exposed reactive groups.

2. The method of claim 1, which further includes, between steps (b) and (c), reacting the surface-exposed monolayer with a bifunctional reagent that reacts with said exposed reactive groups, to produce a coupling layer having exposed reactive groups with which the reactive groups of the selected compound forming the next monolayer can react.

3. The method of claim 2, wherein the surface-reactive groups on the substrate are amine groups, and the bifunctional reagent is a diamine compound.

4. The method of claim 3, wherein the selected compound is a polycyclic

tetracarboxylic-dianhydride compound.

5. The method of claim 4, wherein steps (a) and (b) are carried out N times in succession for a first selected polycyclic tetracarboxylic-dianhydride compound, and M times in succession for a second selected polycyclic tetracarboxylic-dianhydride compound.

6. The method of claim 5, wherein the first and second polycyclic tetracarboxylic-dianhydride compounds are perylene and naphthalene tetracarboxylic-dianhydride compounds, respectively.

7. The method of claim 4, wherein steps (a) and (b) are carried out N times in succession for a first selected polycyclic tetracarboxylic-dianhydride compound, and one or more times in succession for the bifunctional reagent.

8. The method of claim 2, wherein the surface-reactive groups on the substrate are maleimide groups, the selected compound is a polycyclic compound with z-axis amine groups, and the bifunctional reagent is a bismaleimide compound.

9. The method of claim 8, wherein the selected compound is a diamino carbozole.

10. A method of forming a multi-layered structure composed of two or more discrete monomolecular layers, where each layer is composed of molecules of a selected polycyclic aromatic compound having a defined axis oriented substantially normal to the plane of the monolayer, said method comprising one or more repetitions of:

(a) depositing molecules of a selected polycyclic aromatic compound

having a defined axis with a chemically reactive group at each axial end, by vapor phase deposition, onto a substrate having surface-reactive sites capable of reacting with the chemically reactive group in the selected compound, said depositing being carried under conditions which allow chemiadsorption of the selected compound in a molecular monolayer, by covalent coupling of one end of the compound to the substrate, and sublimation of non-covalently bonded compounds from the surface; and

(b)by said depositing, forming on the substrate, a monomolecular layer of the selected compound;

wherein each repetition forms a new substrate having a surface-exposed monolayer with exposed reactive groups.

11. A method according to Claim 10 wherein said axis is a z axis.

12. A method according to Claim 10 wherein the monomolecular layer formed in (b) is characterized by in-plane ordering.

13. A method according to Claim 10 wherein said selected polycyclic aromatic compound is planar.

14. A method according to Claim 10 wherein said vapor phase deposition is carried out under CVD conditions.

15. The method of claim 10, which further includes, before or after at least one of said repetitions, reacting the surface-exposed monolayer with a selected bifunctional reagent that reacts with said exposed reactive groups, to produce a coupling layer having exposed reactive groups with which the reactive groups of the selected compound forming the next monolayer can react.

16. The method of Claim 15 wherein a selected bifunctional reagent is electrically conducting.

17. The method of Claim 16 wherein the electrically conducting bifunctional reagent is selected from oligothiophene and oligoaniline.

18. The method of Claim 15 wherein the bifunctional reagent is electrically

insulating.

19. The method of Claim 18 wherein the electrically insulating bifunctional reagent is selected from $-(CH_2)_n-$, where n is between 1 and 5, and $\phi-(CH_2)_n-\phi$, where n is between 0 and 5 and ϕ represents a phenyl.

20. The method of claim 15, wherein the surface-reactive groups on the substrate are amine groups, and the bifunctional reagent is a diamine compound.

21. The method of claim 20, wherein the selected compound is a polycyclic tetracarboxylic-dianhydride compound.

22. The method of claim 21, wherein steps (a) and (b) are carried out a first number of times in succession for a first selected polycyclic tetracarboxylic-dianhydride compound, and a second number of times in succession for a second selected polycyclic tetracarboxylic-dianhydride compound.

23. The method of claim 22, wherein the first and second polycyclic tetracarboxylic-dianhydride compounds are perylene and naphthalene tetracarboxylic-dianhydride compounds, respectively.

24. The method of claim 21, wherein steps (a) and (b) are carried out a first number of times in succession for a first selected polycyclic tetracarboxylic-dianhydride compound, and one or more times in succession for the bifunctional reagent.

25. The method of claim 15, wherein the surface-reactive groups on the substrate are maleimide groups, the selected compound is a polycyclic compound with z-axis amine groups, and the bifunctional reagent is a bismaleimide compound.

26. The method of claim 25, wherein the selected compound is a diamino carbozole.

27. A multi-layered structure comprising

a substrate,

formed on the metallic substrate, a first monomolecular layer composed of monomers of a first selected polycyclic aromatic compound having a defined axis oriented substantially normal to the plane of the monolayer, with the monomers forming the monolayer being covalently attached at one axial end to the substrate, and

a second monomolecular layer composed of monomers of a second selected polycyclic aromatic compound having a defined axis oriented substantially normal to the plane of the monolayer, with the monomers forming the monolayer being covalently attached at one axial end to an axial end of molecules forming the first monolayer.

28. A multilayered structure according to Claim 27 wherein said axis is a z axis and each of the monomolecular layers being characterized by in-plane ordering.

29. A multilayered structure according to Claim 27 wherein said selected polycyclic aromatic compound is planar.

30. A multi-layered structure according to Claim 27, wherein the monomers in the first monolayer are covalently attached to molecules in the second monolayer through bifunctional reagent molecules forming a monomolecular coupling layer between the two layers formed of polycyclic aromatic compounds.

31. A multi-layered structure according to Claim 30 including a bifunctional reagent that is electrically conducting.

32. A multi-layered structure according to Claim 31 wherein the electrically conducting bifunctional reagent is selected from oligothiophene and oligoaniline.

33. The multilayered structure of Claim 30 including a bifunctional reagent that is electrically insulating.

34. The multilayered structure of Claim 31 wherein the electrically insulating

bifunctional reagent is selected from $-(CH_2)_n-$, where n is between 1 and 5, and $\phi-(CH_2)_n-\phi$, where n is between 0 and 5 and ϕ represents a phenyl.

35. A multilayered structure according to Claim 27, which includes a first number of layers of a first selected polycyclic compound and a second number of layers of a second selected polycyclic compound.

36. A multilayered structure according to Claim 35, wherein the first and second polycyclic compounds are perylene and naphthalene tetracarboxylic-dianhydride compounds, respectively.

37. The multilayered structure of claim 35, wherein the selected compound is formed by polycyclic compound having axial amine groups, and the bifunctional reagent is a bismaleimide compound.

38. The composition of claim 37, wherein the selected compound is a diamino carbozole.

39. A method of forming a multi-layered structure composed of two or more discrete monomolecular layers, where each layer is composed of molecules of a selected polycyclic aromatic compound having a defined axis oriented substantially normal to the plane of the monolayer, said method comprising:

(a) providing a solid surface having surface reactive sites;

(b)depositing on said solid surface a selected coupling agent having a first reactive group, which is capable of reacting with the reactive sites of the said solid surface; and a second reactive group, which is capable of reacting neither with the reactive sites of the said solid surface nor with the said first reactive group;

(c)by said deposition, forming a substrate having surface reactive sites, the substrate being composed of the said solid surface and a template layer chemiacsorbed thereon by covalent coupling of the first reactive group of the coupling agent to the reactive sites of the said solid surface; the surface reactive sites of the substrate are occupied with the second reactive

group of the said coupling agent;

(d) depositing on said template layer molecules of a selected polycyclic aromatic compound having a defined axis with a chemically reactive group at each axial end, by vapor phase deposition, said selected polyciclic aromatic molecules being capable of reacting with the second reactive groups exposed on the said substrate, said depositing being carried under conditions which allow chemiadsorption of the selected compound in a molecular monolayer, by covalent coupling of one end of the compound to the template layer, and sublimation of non-covalently bonded compounds from the surface; and

(e) by said depositing, forming on the template layer a monomolecular layer of the selected compound to form a substrate having a surface-exposed monolayer with exposed reactive groups;

(f) repeating one or more repetitions of

(i) depositing molecules of a selected polycyclic aromatic compound having a defined axis with a chemically reactive group at each axial end, by vapor phase deposition, onto the said substrate having a surface-exposed monolayer with exposed reactive groups; wherein said chemically reactive groups of said selected polycyclic aromatic compound is capable of reacting with the chemically reactive groups of said substrate, said depositing being carried under conditions which allow chemiadsorption of the selected compound in a molecular monolayer, by covalent coupling of one end of the compound to the substrate, and sublimation of non-covalently bonded compounds from the surface; and

(ii) by said depositing, forming on the substrate, a monomolecular layer of the selected compound;

wherein each repetition forms a new substrate having a surface-exposed monolayer with exposed reactive groups.

40. A method according to Claim 39 wherein said solid surface is of a metal.

41. A method according to Claim 40 wherein said surface is of silicone, titanium, indium, iron, copper, gold or platinum.

42. A method according to Claim 39 wherein said solid surface is a semiconductor.

43. A method according to Claim 42 wherein said semiconductor is GaAs or CdSe.

44. A method according to Claim 39 wherein said solid surface has an outer layer of hydroxyl layer.

45. A method according to Claim 39 wherein the coupling agent has a spacer confined between the said first and second reactive groups.

46. A method according to Claim 45 wherein said spacer is an alyphatic, aromatic, inorganic or metaloorgainc moiety.

47. A method according to Claim 39 wherein said axis is a z axis.

48. A method according to Claim 39 wherein the template layer and the monomolecular layers formed in (e) and in (f)ii are characterized by in-plane ordering.

49. A method according to Claim 39 wherein said selected polycyclic aromatic compound is planar.

50. A method according to Claim 39 wherein said vapor phase deposition is carried out under CVD conditions.

51. A method according to Claim 39 wherein the deposition of step (b) is carried out by a solution phase reaction.

52. The method of claim 39, which further includes, before or after at least one of said repetitions and/or before or after the deposition of step (d), reacting the

surface-exposed monolayer with a selected bifunctional reagent that reacts with said exposed reactive groups, to produce a coupling layer having exposed reactive groups with which the reactive groups of the selected compound forming the next monolayer can react.

53. The method of Claim 52 wherein a selected bifunctional reagent is electrically conducting.

54. The method of Claim 53 wherein the electrically conducting bifunctional reagent is selected from oligothiophene and oligoaniline.

55. The method of Claim 52 wherein the bifunctional reagent is electrically insulating.

56. The method of Claim 55 wherein the electrically insulating bifunctional reagent is selected from $-(CH_2)_n-$, where n is between 1 and 5, and $\phi-(CH_2)_n-\phi$, where n is between 0 and 5 and ϕ represents a phenyl.